IES Newsletter

Volume 15, Number 1
January - February 1998

The Institute's greenhouse was built in 1972 and first served as a plant propagation facility for the Mary Flagler Cary Arboretum. Now, it is many things to many users: a controlled laboratory environment for ecological researchers, a giant classroom where students explore plant growth and biodiversity, a nursery where gardeners grow plants destined for the Perennial Garden, the Fern Glen and the IES Ecology Shop, and a place where visitors can take a mini-vacation to a tropical climate.

The greenhouse recently celebrated its 25th anniversary with an Open House, which you will read about on page 3 of the newsletter. IES educators now are beginning a series of ecological experiments for the general public. As the facility begins its second quarter century, keep an eye out for new things to explore!

The IES Newsletter is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

Director: Gene E. Likens
Administrator: Joseph S. Warner
Head of Education: Alan R. Berkowitz
Newsletter editor: Jill Cadwallader

Address newsletter correspondence to the editor at:
Institute of Ecosystem Studies
Education Program, Box R
Millbrook NY 12545-0178

e-mail: cadwalladerj@ecostudies.org

Printing: Central Press, Millbrook, N.Y.

How Do Small Mammals Shape the Landscape?

Is it a weather balloon? A wayward entry in the Great Hudson Valley Balloon Race? How about a UFO? Well, as a matter of fact, the helium balloon that sometimes hovers over fields at the Institute of Ecosystem Studies could indeed be considered an "unidentified flying object" since few would correctly identify it as a tool to measure vegetation.

The balloon belongs to IES graduate student Robert Manson. To learn more about the factors influencing seed and seedling predation by small mammals in old-fields, and ultimately how these small mammals influence patterns of tree establishment in these habitats, Mr. Manson needed to do seed and seedling predation studies while simultaneously measuring the movement of animals and the structure of vegetation. The movement patterns of animals — in this case, meadow voles and white-footed mice — were relatively straightforward to determine through trapping and radio telemetry: caught in live-traps, the animals are fitted with a tiny radio collar[1] and released at the site of capture. Their movement routes and range are tracked electronically.

Measuring the distribution and abundance of different types of vegetation in these old-field sites without disturbing natural movement patterns of the small mammals proved more difficult. Traditional sampling techniques, which usually involve walking across the study plots, would have changed the structure of the vegetation and thus would have confounded efforts to determine the effects of the old-field plant community on the movement and foraging patterns of small mammals. Mr. Manson came up with a non-intrusive way to measure and record vegetation in his old-field sites: aerial photography, using a 35-mm camera carried aloft by a helium balloon.

Seeds and Seedlings in Old-fields

To understand Mr. Manson's study more completely, we need some history. An "old-field" is a former pasture or cultivated field, abandoned and subsequently invaded first by herbaceous plants and then by shrubs and trees. This natural process is called succession. Economic

continued on page 2

1. Radio telemetry devices that weigh less than 10% of an animal's body weight have no detectable effect on the behavior and survival of the animal. For example, voles, which weigh approximately 23 grams (there are just over 28 grams in an ounce), are fitted with radio collars weighing 2.2 grams. Most of that weight is the battery. These devices have a range of 100 meters (109 yards) and a life-expectancy of 30 days.

SHLOMO BRANDWINE

IES graduate student Robert Manson, right, prepares to do aerial photography of his old-field sites. Assisting him are an IES exchange student and volunteer Maj Padamsee (hidden).

and social conditions from the mid-1800s to the mid-1900s led to gradual abandonment of agricultural fields by farmers in New York and New England. The resulting landscape is a mosaic of expanding forest fragments and surrounding old-fields. (Visitors to the Institute will find a classic example of an old-field at the eastern end of the Wappinger Creek Trail.) The forest edge, where woods meet field, is the most dynamic part of this landscape. Factors influencing the ease with which seeds and seedlings invade old-fields can have important consequences for the diversity of organisms living along these boundaries as well as for the flow of energy and material across them.

In 1994, Mr. Manson was completing his master's degree at Rutgers University; Dr. Richard Ostfeld was on his master's committee. Dr. Ostfeld, an IES animal ecologist, and colleague Dr. Charles Canham, a plant ecologist, were searching for a graduate student in a four-year doctoral program to work on a new study, the "Cryptic Keystone Species Project", aimed at discovering the role that small mammals play in influencing tree establishment in old-fields. Mr. Manson joined the team, beginning a Ph.D. program at the Institute with Dr. Steward Pickett, a plant ecologist, and Dr. Ostfeld as his co-advisors.

The collaborators set up paired, U-shaped enclosures, 40 x 40 meters (130 x 130 feet) along forest edges. The open ends of the "U" extended 5 meters into the forest with the remaining 35 meters in old-fields, a design that permitted animals to leave or enter only through the opening in the forest. Within these enclosures the scientists manipulated the density of meadow voles (high vs. low) and studied the effects of fluctuations in vole density on the survival of tree seeds and seedlings. Voles, which consume tree seedlings, can undergo dramatic fluctuations in density over the course of a year. Voles also can competitively exclude mice, which feed on seeds. The researchers postulated that fluctuations in vole density might be key in providing windows of opportunity for tree establishment in old-fields. Since voles greatly prefer grass-dominated areas and rarely if ever move into the forest, low- and high-density populations were relatively easy to maintain. Mice, on the other hand, prefer to live in forests and along forest edges, so the experimental enclosures themselves had no effect on their occasional movements out into old-fields to feed. Using this experimental design, the researchers studied the effects of seed and seedling predation by mice and voles on tree colonization in old-fields.

Are other species capable of taking over the role of species that disappear? This is a critical question for those debating the importance of biodiversity, and, at least in the case of these predation studies, the answer appears to be a resounding, "No!" As expected, voles appeared to be the main seedling predator while mice were the main seed predator in these studies. When vole numbers were high, seedling survival in the grass-dominated portions of the plots decreased while seed survival increased, since mouse foraging was more constrained in the presence of their primary competitor. When vole numbers were low, survival rate of seedlings was higher but mice were more abundant and the predation on seeds along forest edges and in shrubby areas increased.

It was clear from these experiments that white-footed mice and meadow voles have totally different effects on tree establishment in old-fields: mice and voles preferred to feed on different species of trees, in different habitats within old-fields, at different distances from the forest edge, and they exhibited contrasting responses to variation in seed and seedling density. It also was clear that small mammals may play an important role in plant succession, since they killed almost 100% of seeds and seedlings when their densities were high. [One paper describing these predation studies has been published in the journal *Ecology* (Volume 78, Number 5) and another has been accepted for publication later this year in *Ecoscience*.]

Which Came First ... the Seedlings or the Voles?

Mr. Manson became convinced that patterns of seed and seedling survival along forest edges were being driven by strong links between vegetation patterns in old-fields and the foraging patterns of mice and voles. In other words, he suspected there were dynamic interactions between the animal and plant communities in old-fields such that each was influencing the other. Mice and voles clearly influence patterns of seed and seedling survival, but what drives these animals to forage in certain areas in the first place? The answer, Mr. Manson felt, was that plant communities in the animals' own home ranges influence their abundance and movement patterns.

SHLOMO BRANDWINE

To test his theory, Mr. Manson is using three research plots, each comprising forest edge and adjacent old-field. For two consecutive years he is conducting predation studies, monitoring animal movements, and doing a census of the plant community within these plots. For aerial surveys of the old-field vegetation he first needed to build a lightweight platform that would hang from the balloon and hold the camera steady. He took the concept to the Institute's Operations and Maintenance Department, where Bob Myers, Paul Dubonis and Dick Livellara helped design and build the apparatus. To collect data, Mr. Manson floats the camera to a height of 70 - 80 meters (230 - 260 feet) over the study site (see photograph above). Holding it stationary with guy wires, he uses a radio triggering device to snap the shutter and advance the film. The resulting photographs, showing vegetation over a wide foraging area, are imported into a Geographic Information System (GIS), a configuration of computer hardware and software that captures, stores, analyzes and displays geographic information. Data from live-trapping and radio telemetry, as well as the seed and seedling predation studies conducted at the same time, are likewise entered into the GIS.

The results should answer the question: What is it about the vegetation that influences where animals move and where they feed?

Another important question is: How strong are the effects of mice and voles versus all the other things that may hinder the ability of trees to colonize old-fields? If tree seeds rarely germinate in old-fields, or if insects and other animals kill most young seedlings, then perhaps the effects of mice and voles really aren't that important in the long run. To address this issue, Mr. Manson used the results of previous experiments to generate predictions about how mouse and vole foraging should be influencing natural patterns of tree establishment in old-fields. He plans to test these predictions in two ways. First, he will compare his predictions to censuses of natural patterns of seedling establishment along utility rights-of-way that were done by Institute scientists in the late 1980s and early 1990s[2]. He also will examine natural patterns of seedling recruitment within the experimental enclosures in which vole densities have been manipulated for four years. If voles and mice are important in determining patterns of tree invasion in old-fields, then four years of manipulating vole density should show detectable differences in patterns of seedling recruitment.

After he has completed his studies here, Mr. Manson plans to use the techniques and hypotheses developed at IES to help the regeneration of Mexican cloud forest. He has a two-year grant from the Mexican Fund for the Conservation of Nature for this research, and he will be collaborating with scientists from the Instituto de Ecologia, Veracruz, Mexico. Mexico's endangered cloud forest is home to over 12% of all the plant and animal species in Mexico, but rapidly is being cleared for coffee plantations and cattle grazing. If small mammals are as important for tree invasion in tropical areas as they appear to be in the Temperate Zone, then understanding the factors influencing their distribution and abundance may be critical to development of management plans to aid the regeneration of this important habitat.

Reflecting on his time spent at IES, Mr. Manson says he feels very fortunate to have had the opportunity to work with the team of scientists at IES, and notes, "I really enjoyed the combination of theory and research that was such an integral part of science conducted at the Institute. Wherever I wind up in the future, my experiences here have done a great job in preparing me to play an active part in the science of ecology!"

*****

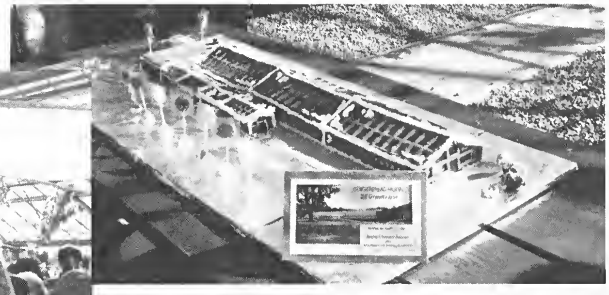
Robert Manson plans to complete his doctoral dissertation at Rutgers University this spring.

---

2. This study was done to learn how tree growth along rights-of-way (which are basically old-fields) could be controlled in ways that were more efficient than routine cutting and less harmful to the environment than the use of herbicides. IES ecologists determined that a shrub cover along rights-of-way was the best way to inhibit tree establishment. Shrubs shade tree seedlings and keep them small for longer periods. This allows more time for predation by mammalian herbivores, which were discovered to be critically important in preventing tree establishment.

---

25 Years at the Greenhouse



JILL CADWALLADER

Above: *Gingerbread model of the IES greenhouse — done to scale! — complete with glass panels made of rock candy.*
Left: *Greenhouse manager David Bulkeley and assistant Rebecca Curtis (hidden) serve cake and sparkling grape juice to Open House guests.*

The afternoon of February 8th brought over 600 people to the IES greenhouse. The occasion? ... an open house in celebration of 25 years of service to research, education and the plant-loving public. The tropical atmosphere was a welcome respite from mid-winter weather, and children and adults alike explored the plant collections, followed the "Economic Botany Trail", planted herb seeds to take home, made origami flowers, went on a plant treasure hunt and marveled at a scale model of the greenhouse made of gingerbread by Julie Hart (research assistant) and Kris Desmarais (ecology educator).

The greenhouse is open Monday through Saturday from 9 a.m.- 3:30 p.m. and Sunday from 1 - 3:30 p.m. Admission is by free permit from the IES Gifford House Visitor and Education Center.

INSTITUTE OF
ECOSYSTEM STUDIES
Education Program
Box R
Millbrook, New York 12545-0178

Newsletter

Volume 15, Number 1
January - February 1998

Calendar

CONTINUING EDUCATION

For a **Winter/Spring 1998** catalogue and program information, call the Continuing Education office at 914/677-9643. Programs during March and April include:

Landscape Design

Mar. 21: **History of Landscape Design**
Mar. 28: **Walks and Steps**

Gardening

Mar. 21: **Basic Cultural Techniques for Perennials**
Mar. 22: **Pruning Trees & Shrubs**
Apr. 2 (6): **Insect Pests & Diseases of Plants**
Apr. 4: **Compost Clinic**
Apr. 4: **Invasive Exotic Identification and Control**
Apr. 4 (4): **Woody Plants for the Landscape**
Apr. 18: **Elegance for Quiet Places: Moss Gardens and Hardy Ferns**
Apr. 18: **Stone Wall Construction**
Apr. 19: **Water Gardens**
Apr. 25: **Ecological Pest Management**
Apr. 26: **Wild Plant Ident.: Early Spring**

Natural Science Illustration

Mar. 18-20: **Pen and Ink I: Techniques**
Mar. 18-20: **An Introduction to Colored Pencil**
Mar. 21-22: **Graphite & Charcoal Techniques**
Apr. 6 (6): **Botanical Watercolor Illustration**

Biology and Earth Science

Mar. 28: **Amazing Gourds**
Apr. 20 (5): **Plant Pharmacy**

Workshops

Mar. 28: **Critical Elements of Ecology for Landscape Design**
Apr. 25: **Summer Bloom in the Garden**

Ecological Excursions and Garden Tours

Apr. 25: **Ecology of Black Rock Forest**

GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 3:30 p.m. daily except public holidays. Admission is by free permit (see "HOURS").

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on occasional Sundays. Call 914/677-5359 to confirm the day's topic or, in case of poor weather, to learn the status of the day's program. Meet at 2 p.m. at the Gifford House on Route 44A for:

Apr. 5: **Farms, Fields and Forests**, a walk led by Dr. Charles Canham
May 17: **Super Soil: The World Beneath Our Feet**, a walk and activity led by Ecology Educator Alan Lorefice
• *We recommend that participants wear long pants tucked into socks and sturdy waterproof shoes for all outdoor programs.*

IES SEMINARS

Free **scientific seminars** are held each Friday at 11:00 a.m. at the IES Auditorium:

Mar. 27: **Microbial Cycling of Nitrogen in Alpine Tundra**. Dr. Melany C. Fisk, Cornell Univ.
Apr. 3: **Hydrologic Controls on DOC Flux in an Upland Catchment**. Dr. Elizabeth W. Boyer, Cornell Univ.
Apr. 17: **Has Forest Fragmentation Really Caused the Decline of Migratory Birds?** Dr. Therese Donovan, SUNY ESF
Apr. 24: **Biochemistry and the Ribosome: Biological Stoichiometry in Ecosystems.** Dr. James Elser, Arizona State Univ.
May 1: **Ecosystem Engineering by Fishes in Tropical Andean Streams**. Dr. Alexander S. Flecker, Cornell Univ.
May 8: **Microbial Metabolism of Dissolved Organic Carbon in Stream Sediments**. Mr. William Sobczak, Cornell Univ. and IES

VOLUNTEER OPPORTUNITIES

For information on volunteering at IES, call Ms. Su Marcy at 914/677-5359.

IES ECOLOGY SHOP

New in the Shop ... pressed flower picture frames, desk accessories ... **for children** ... new toys, puzzles and games ... **and in the Plant Room** ... "EZ diggers" (long- & short-handled), tropical foliage plants from the IES greenhouse
Senior Citizens Days: 10% off on Wednesdays
•• **Gift Certificates** are available ••

HOURS

Winter hours: October 1 - April 30
Closed on public holidays.
Public attractions are open Mon. - Sat., 9 a.m.-4 p.m. & Sun. 1-4 p.m., with a free permit*.
The **IES Ecology Shop** is open Mon.- Fri., 11a.m.-4 p.m., Sat. 9 a.m.-4 p.m. & Sun. 1-4 p.m. (The shop is closed weekdays from 1-1:30 p.m.)

* *Free permits are required for visitors and are available at the IES Ecology Shop or the Education Program office daily until 3 p.m.*

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the newsletter, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program. Individual membership: $30; family membership: $40. Call Ms. Janice Claiborne at 677-5343.

The Institute's Aldo Leopold Society
In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call Ms. Jan Mittan at 677-5343.

TO CONTACT IES ...

... for research, graduate opportunities, library and administration:
Institute of Ecosystem Studies
Box AB
Millbrook NY 12545-0129
Tel: 914/677-5343 • Fax: 914/677-5976
Street address: Plant Science Building, Route 44A, Millbrook, N.Y.

... for education, general information and the IES Ecology Shop:
Institute of Ecosystem Studies
Education Program, Box R
Millbrook NY 12545-0178
Tel: 914/677-5359 • Fax: 914/677-6455
Street address: Gifford House Visitor and Education Center, Route 44A, Millbrook, N.Y.

... internet address:
www.ecostudies.org